WPI Husky
FS Communications & Charging Rack

System Developer's Guide

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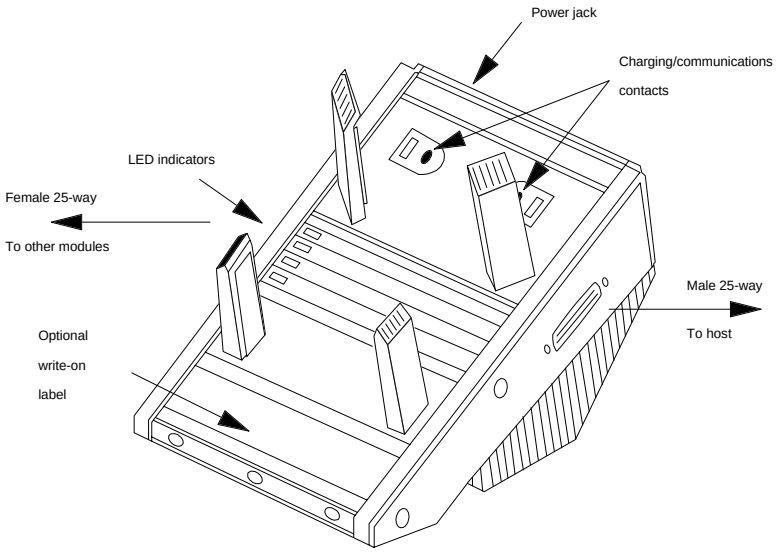
1. Introduction

Throughout this publication, the phrase **FS CCR** means the **Husky FS Communications & Charging Rack**. The phrase **FS unit** refers to Husky handheld computers that can be used with the **FS CCR**, such as the **Husky FS/2** and **Husky FS3**.

Note: Please refer to the sections on AC Adaptor Precautions and Electromagnetic Compatibility near the end of this guide for important safety and statutory information.

1.1 The FS CCR

The **FS CCR** provides a communications path and charging facility for suitably equipped Husky handheld computers such as the **Husky FS/2** and **Husky FS3** (**FS** units). To connect an **FS unit**, you simply place it onto the **FS CCR** and its spring contacts engage to connect power, turning on the **FS** unit and beginning charging automatically.



If the **FS** unit is running a suitable application, it can detect that connection has been made, and communicate via the same contacts with a desktop computer or modem connected to the **FS CCR** via a standard 25-way D type connector. Communications can be at up to 38,400 Baud, and can support individual and broadcast modes.

The **FS CCR** can be easily extended by adding further modules. It can be desk- or wall-mounted for user convenience and carries a number of indicator LEDs for simple monitoring.

1.2 Using this guide

1.2.1 Structure

This guide is divided into the following chapters:

1: Introduction	A brief introduction to the **FS CCR** and this guide, which you should read first.
2: Setting up	How to unpack and set up the **FS CCR**, and extend it (by adding further modules).
3: Operator instructions	How to use and maintain the **FS CCR**.
4: Programming	How to write applications to use **FS CCR** for communications. You should read this information in conjunction with the System Developer's Guides for the Husky computers that will be used with it, such as the *Husky FS/2 and FS3 System Developer's Guides*. You may also need to refer to the MS-DOS Programmer's Manual if you are not already familiar with programming under MS-DOS.

5: Appendices	Summary technical data, for ease of reference.
AC Adaptor Precautions	Precautions that you must read and understand before using the **FS CCR AC Adaptor** to power the **FS CCR**.
Electromagnetic Compatibility (EMC)	Statutory information and statements on electromagnetic compatibility of the **FS CCR**.

There is also a detailed index at the end of the guide.

1.2.2 Suggested reading approach

Whatever your interests, you should start by reading the rest of this chapter (Introduction). Then:

- If you are installing the **FS CCR**, read Chapter 2.
- If you are going to operate the **FS CCR**, read Chapter 3.
- If you are writing applications to use the **FS CCR**, read Chapter 4.

1.2.3 Conventions

Throughout this guides, a few simple conventions are used to help clarify descriptions. These are mainly used to indicate text to type, as follows.

`DIR`	this is text which should be typed exactly as shown. If you prefer, you may type it as the equivalent small letters (d i r).
`filename`	this is a description of text to type, rather than the actual characters. In this case, you should type the name of a file (for example, PROGRAM1).

this is a name or symbol representing the key that you should press or hold down. In most cases, the name or symbol is the same as appears on the key.

[,A] — this is an optional part of the text ie text which may be omitted or typed, depending on what you want to do.

Enter new date — text as it appears on the screen.

These conventions are often used in combination. For example:

DIR [filename] means type D I R and then a space, then either press the key, or type the name of a file and press .

1.2.4 Special terms

Within this guide, a few special terms are used for conciseness, as follows:

host — The computer system which is communicating with the **FS** units on the **FS CCR**, such as a desktop PC, minicomputer or mainframe. This will require a custom application for this purpose. The host may be connected directly or via a modem.

the **FS/2** — An **FS/2** handheld computer.

the **FS3** — An **FS3** handheld computer.

the **FS** unit — A Husky **FS3** handheld computer, such as the **FS/2** or **FS3**.

Rack module — An **FS CCR** installation can consist of a number of modules, each of which supports a single **FS** unit at a time. An installation shares a single host connection.

1.3 The other guides

You may also need to refer to other standard documentation, including:

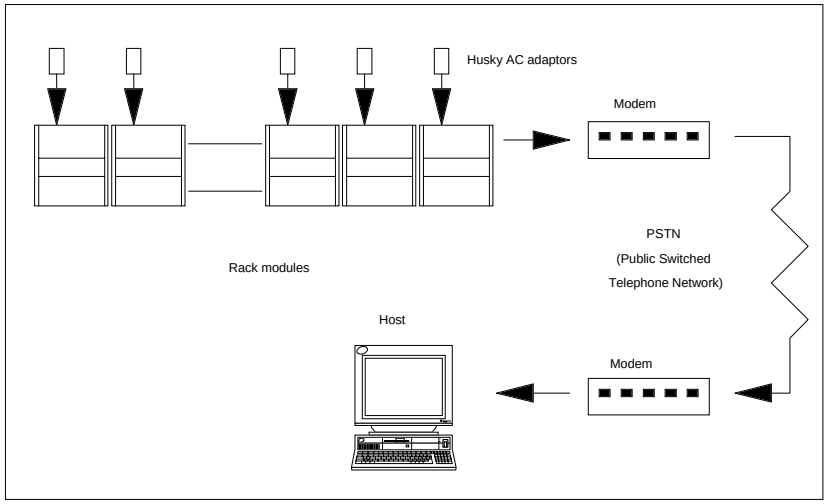
Husky FS CCR User & Installation Booklet	Describes how to install and operate the **FS CCR**.
FS/2 User Leaflet, FS3 User Leaflet, etc.	Tells an operator how to use and look after the **FS** unit.
Husky FS/2 and FS3 System Developer's Guides, etc.	Technical information, for the personnel who maintain and develop software for the **FS** unit. These guides: • Introduce you to the **FS** unit. • Explain how to set up, maintain, fault-fix and expand the **FS** unit, including details of commands which are not provided by a desktop MS-DOS computer. • Provide additional technical information that you will need to write or adapt programs for the **FS** unit, concentrating on details that are different to a desktop MS-DOS computer.
The Husky File Transfer Utility Guide	How to use the Husky HCOM utility to transfer files between an **FS** unit and a PC compatible.

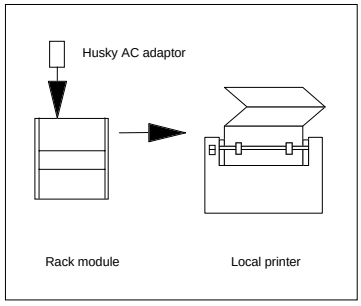
IMPORTANT: You should supply operators with the appropriate User Leaflet for the type of **FS** unit being used - this leaflet contains important Safety and Legislative information.

You should also supply operators with information on using the application which you install on the **FS** unit. You may also want to provide them with additional information (such as how to change batteries), if they have to cope with such situations on their own.

2. Installing

Some typical Husky **FS CCR** installations:





2.1 Introduction

Read this chapter before installing one or more **FS CCR** modules. It tells you how to:

- Prepare for the installation
- Choose a site
- Mount the **FS CCR** to a wall
- Mount the **FS CCR** on a desk top
- Connect up
- Check operation
- Extend an installation

2.2 Unpacking and preparation

Unpack and check the **FS CCR** modules for any obvious signs of damage. If you wish to use the supplied self-adhesive user label, peel it from the backing and apply it to the recess on the front of the Rack module (see section 1.1).

Power supplies, cables, mounting kits and Rack joining kits are all optional and available separately.

Power:
To power the **FS CCR**, you must supply a nominal 12V 750mA DC to each Rack module, using Husky-approved power supplies, such as the optional **FS CCR AC Adaptor**. The power supplies must supply the following:

Nominal current	750mA per Rack module
Minimum current	700mA per Rack module
Nominal voltage	12.0V
Minimum voltage	11.0V (at the Rack module input)
Maximum (continuous)	15.0V

The power connector should be wired as described in Appendix A.3. For information on installing power supplies, see section 2.6.

Cables:
For connection direct to a host or local printer, you will need a "crossed" (null modem) cable. For connection via a modem, you will need a "straight" (1-1, 2-2, etc) cable. If you are interconnecting **FS CCR** installations, you will need a "straight" 25-way to 25-way cable.

Suitable cables are available as options, or see Appendix A for connector pinouts and cable wiring diagrams.

Mounting kits:
A mounting kit consists of a bracket and screws which fixes to a vertical surface or wall. **FS CCR** modules can then be easily mounted onto it.

A Rack joining kit consists of joining bars and screws, which fasten to the rear of **FS CCR** modules to increase the rigidity of a multi-module installation. They are recommended for any desk or bench installation that consists of more than one Rack module.

Tools:
For desk-mounting, you should not need any tools, other than an Allen key, if you are using the optional Rack joining kit.

For wall-mounting, you will need an Allen key, screwdriver, spirit level, and the appropriate tools and accessories for screwing the bracket to the wall (such as a masonry drill and wall plugs).

2.3 Choosing a site

When choosing a site for the **FS CCR** installation, note the following:

- The conditions at the site must comply with the environmental details listed in Appendix B.3.
- The **FS CCR** is designed to be mounted either on a vertical surface or on a desk. Desk installations of more than one Rack module should use the optional Rack joining kits, while vertical mounting requires the optional wall-mounting kit.
- The location should have easy access (for mounting and demounting **FS** units), but be unlikely to be knocked in normal use.

- The location should have the appropriate number of AC outlets within easy reach (such as one per **FS CCR** AC adaptor).
- The right-hand end of the **FS CCR** connects to the host's communications connector or to a modem link.
- If the installation is likely to be expanded, remember to choose a location which has sufficient space, to minimise the additional effort required.

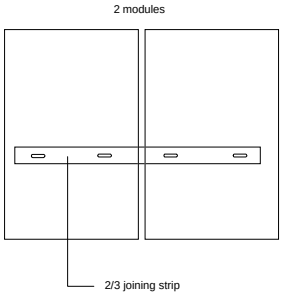
2.4 Interconnecting multiple Rack modules

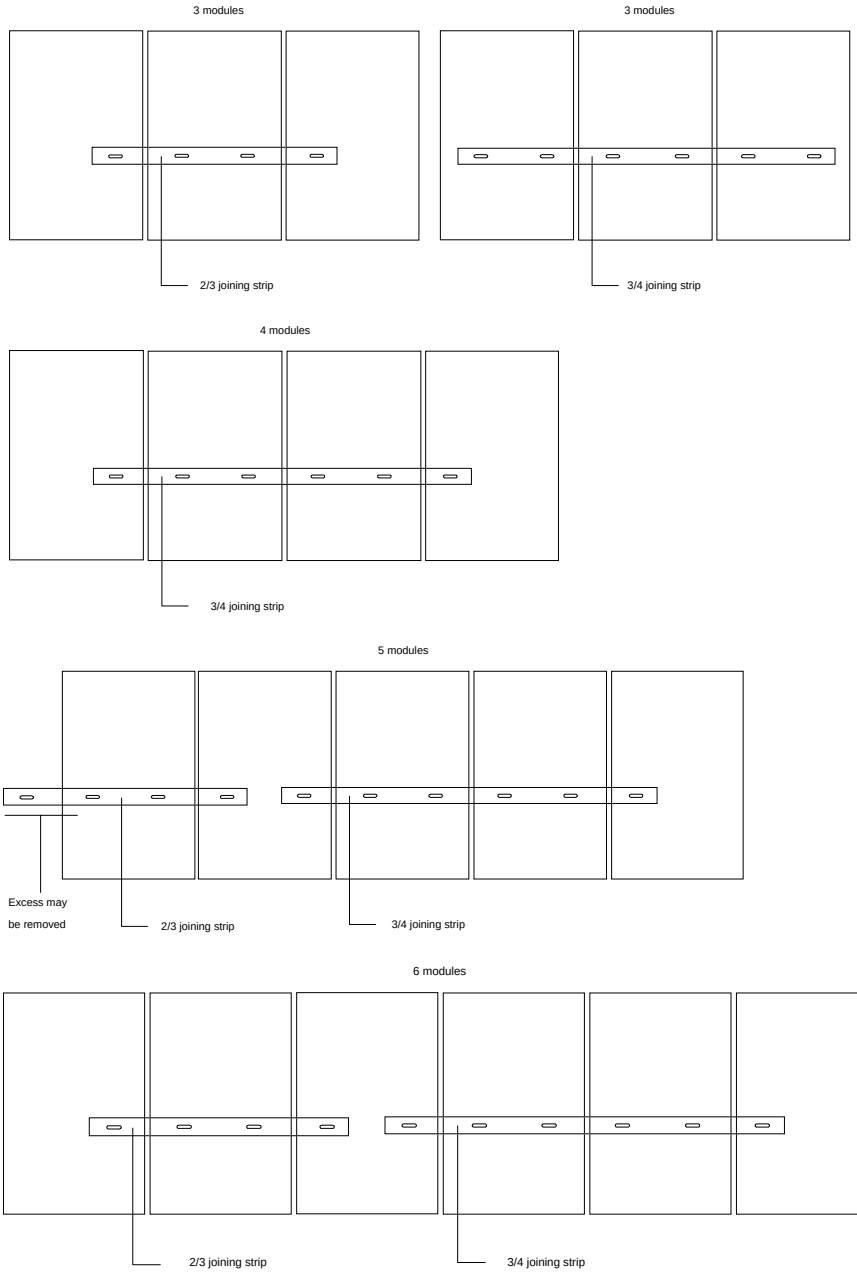
If you are connecting more than one Rack module, simply line up the mating male and female 25-way connectors on the sides of each Rack module, then push them together.

For desk or bench-mounted installations of multiple modules, you are advised to fit joining bars across the Rack modules. These are supplied with the appropriate screws in the form of Rack joining kits. A kit consists of:

- one joining bar suitable for joining two or three modules
- one joining bar suitable for joining three or four modules
- all screws required

Check that you have sufficient Rack joining kits before beginning. For example, with a single kit you can join between 2 and 6 Rack modules:

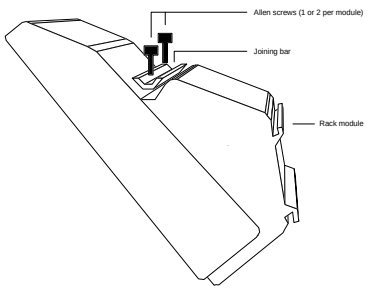



3 modules
3 modules
2/3 joining strip
3/4 joining strip
4 modules
3/4 joining strip
5 modules
Excess may
be removed
2/3 joining strip
3/4 joining strip
6 modules
2/3 joining strip
3/4 joining strip

To fit the joining bars:

- Turn the **FS CCR** modules over.
- Position the joining bar so that it bridges the Rack modules and the holes line up.

  It fits to the underside of the modules like this:

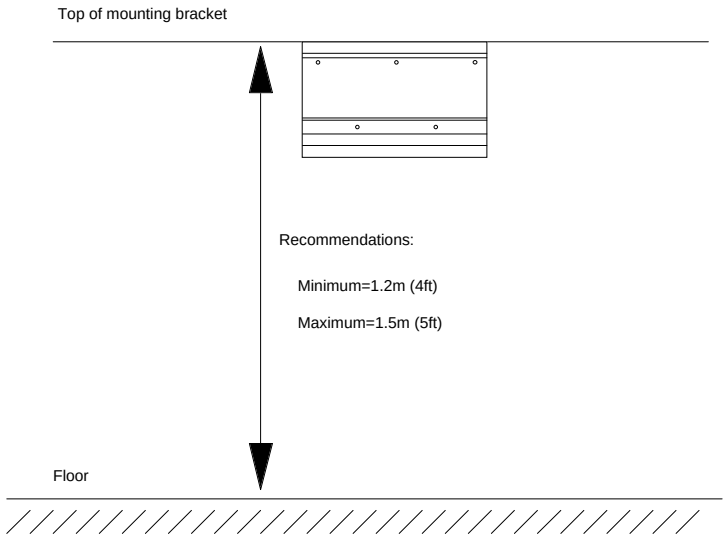


- Insert and tighten the supplied Allen screws.
- When you have fitted all the joining bars, turn the **FS CCR** modules the right way up again.

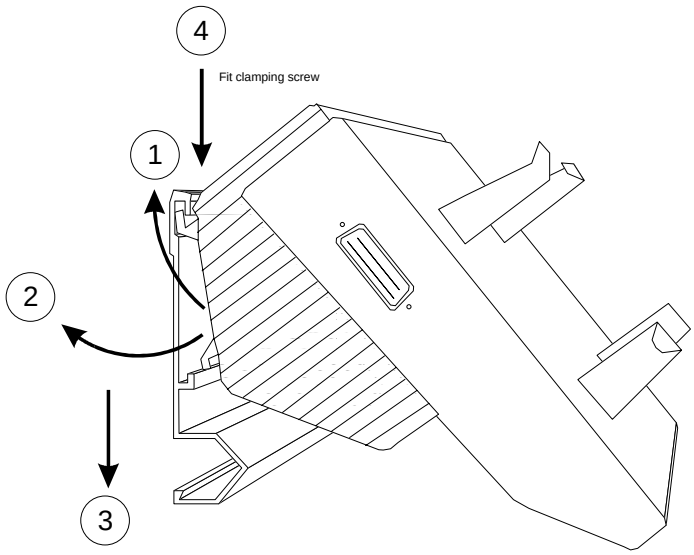
2.5 Wall-mounting

Mounting kits can be used to mount the **FS CCR** on any suitable vertical or nearly vertical surface. To mount the **FS CCR**, you will need the appropriate number of mounting kits. Kits are available in three versions: for a single module, for up to four modules and for up to six modules. The kits for multiple modules can be cut to suit fewer modules if required.

- The tools and fittings you need depend on the wall type and number of modules. For example, if you are fastening to a masonry or brick wall, you will need a masonry drill and wall plugs; if you are wall-mounting fewer modules than the kit supports you may choose to cut off the surplus wall bracket, using a hacksaw (although this is not essential).
- Mark a horizontal line on the wall where you want to place the top of the brackets, using a spirit level to ensure that it is level. This line will help you accurately align the brackets when you screw them to the wall; if you are using more than one bracket, correct alignment is crucial.



- Using a bracket as template, mark the fixing hole positions on the wall. Select sufficient holes to produce a secure fixture: at least 3 on short lengths, more on the longer lengths.
- If necessary, drill and plug the holes.
- Screw the brackets to the wall using pan head or round head (but not countersunk) screws. This will allow you to make slight adjustments to positioning, as the bracket screw holes are oversize. Do not over-tighten the screws, as this may distort the brackets if the wall is not completely flat.
- Once the bracket is fastened to the wall, engage the top of the extrusion at the top of each **FS CCR** module upwards into the lip (1) at the top of the bracket, tilt the **FS CCR** toward the wall as far as it will go (2), and then slide it down into the retaining slot (3):

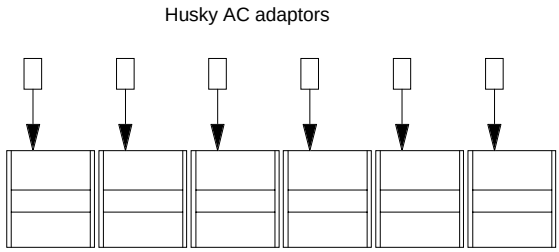


Or, if there is enough room, simply slide the modules into the brackets from the side.

- Slide adjacent Rack modules together so that their D type connectors mate fully.
- Fit the supplied small Allen head screws to the top of the brackets (one per module) and tighten them for additional stability (4).

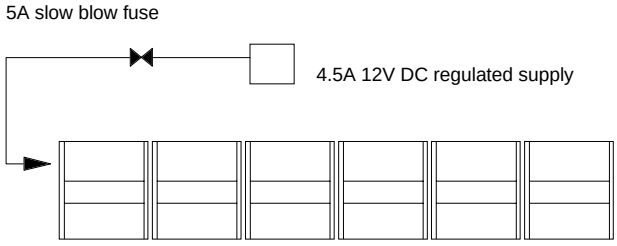
2.6 Connections

- Check that each Rack module is properly connected to the next via their D type connectors.
- Connect DC power as follows:
    - If you are using the **Husky AC adaptors**, connect an adaptor to the power socket at the top of each Rack module and plug each adaptor into a convenient AC outlet:



Note: Each Rack module must have its own AC adaptor connected.

- Alternatively, you can use 4.5A 12V DC regulated power supplies with a 5A slow blow fuse, to supply power to up to six Rack modules at a time via the lefthand D type:



See Appendix A.1 for details of the D type pinouts.

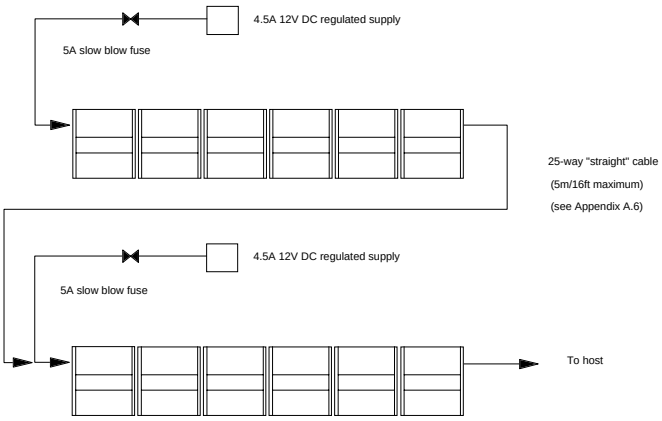
Caution: Power supplies must be installed by a competent person.

- Connect the right-hand end of the **FS CCR** to the host connector, local printer or modem:
  - To connect direct to the host, use a "crossed" (null modem) cable.
  - To connect via a modem, use a "straight" (1-1, 2-2, etc) cable.
  - To connect to a local serial printer, use a "crossed" (null modem) cable.

  See Appendix A.1 for D type pinouts and Appendix A.6 for cable details.

Caution: Refer to section 2.7 for information on complying with EMC legislation.

- If you are interconnecting several groups of **FS CCR** modules, you will need a "straight" 25-way to 25-way cable. The following example shows how to combine this with supplying power to each group of modules via the D-type connectors:



Caution: No more than 6 FS CCR modules can be supplied with power via one D-type.

The recommended maximum cable length is 5m (16ft). See Appendix A.1 for D type pinouts and Appendix A.6 for cable details.

Caution: Refer to section 2.7 for information on complying with EMC legislation.

In a wall-mounted installation, you can route communications and power cables just below the wall brackets (where they are partially out of sight) and clip it to the wall.

If you are using a modem link, install it as per the modem supplier's instructions.

2.7 EMC and FCC legislation

To ensure compliance with EMC legislation:

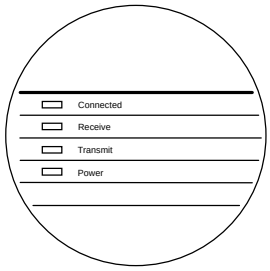
- Changes or modifications could void the user's authority to operate the equipment.
- Use the **FS CCR AC Adaptors** to power the **FS CCR**. If installing alternative power supplies as described in section 2.6, it is the installer's responsibility to ensure that the overall system complies with local EMC regulations.
- All communications cables must be shielded, with the shield grounded. Use approved cables.
- The maximum system configuration may be limited by local EMC regulations. WPI Husky Ltd. has EMC certification for systems comprising up to 32 interconnected **FS CCR** modules.
- The **FS CCR** must only be used with approved peripherals and approved power supplies.

Also see the 'Electromagnetic Compatibility' section, near the end of the guide.

2.8 Checking operation

- Turn on each AC adaptor and check that the POWER LED lights on the appropriate Rack module:

  IF IT DOES NOT, try another adaptor and AC outlet. If this does not light the LED, the Rack module is probably faulty.



- Mount an **FS** unit on each Rack module in turn and check that the appropriate CONNECTED LED lights.

  IF IT DOES NOT, clean the contacts on both the Rack module and the **FS** unit and check that the Rack module's spring contacts are not sticking. Check that the **FS** unit is fitted with the **Rack Interface** option. Try another **FS** unit. If none of this helps, the Rack module may be faulty.

To see if an **FS/2** unit is fitted with the **Rack Interface** option, check its product code, which is in the form H-xxx-xnxx. If the "n" character is a number (not a letter), the interface option is fitted.

To see if an **FS3** unit is fitted with the **Rack Interface** option, check that the configuration on its rear label includes **/RACK/**.

- Load the communications application on an **FS** unit and mount it on the right-hand Rack module (nearest the host connection). Run the application on the host and **FS** unit and check that the RECEIVE and TRANSMIT LEDs flicker, and the application behaves correctly. (If the application is not available yet, a simple test can be carried out by using HCOM, the Husky file transfer utility. Refer to section 3.6.)

  IF COMMUNICATIONS DO NOT OPERATE, check the cable, and the applications running on the host and **FS** unit. Make sure that the cable is correct and plugged into the right-hand end of the **FS CCR**. Try another **FS** unit. Check that the **FS** unit is fitted with the **Rack Interface** option (as described above)! Swap the right-hand end Rack module with another and try again.

- Finally, mount the **FS** unit on the lefthand Rack module (furthest from the host connection), run the application and check that the LEDs light again.

  IF COMMUNICATIONS DO NOT OPERATE, the Rack modules are not daisy-chaining correctly. Move the **FS** unit one module to the right and try again, repeating until communications operates properly; the daisychaining problem lies in this module or the one to its left. To determine which is at fault, swap Rack modules.

- If you experience occasional or intermittent communications errors, check carefully that your cable connections conform to those shown in Appendix A.6. In particular, if you are running at speeds greater than 19,200 Baud it is important that the CTS and RTS pins are not connected (or are permanently driven into the active state). It may not be sufficient to merely disable the CTS/RTS handshaking at the software level. The Husky HCOM file transfer utility is designed to operate without CTS/RTS connected.

More information on troubleshooting is included in section 3.10.

The **FS CCR** is now ready for use.

2.9 Extending the installation

To extend an **FS CCR** installation, you need to purchase the appropriate number of **FS CCR** modules, AC adaptors, joining kits and mounting kits, and then fit them as described earlier in this chapter.

Caution: Disconnect the AC adaptors before plugging or unplugging Rack modules.

Each module in the **FS CCR** delays signals by another 5 microseconds, so in a system of more than about 25 modules the maximum Baud rate may be reduced to 19,200. The maximum recommended size for a single **FS CCR** installation is 50 modules.

Caution: The maximum system configuration may be limited by local EMC regulations. WPI Husky Ltd. has EMC certification for systems comprising up to 32 interconnected FS CCR modules. Consult your system supplier for advice. Refer to section 2.7 for information on complying with EMC legislation.

To make a large installation more manageable, you can interconnect groups of Rack modules by using a cable as described in section 2.6.

2.10 Vehicle mounting

Please consult the supplier of your **FS** units.

Caution: Safety issues may apply.

3. Operating Instructions

Note: To use the **FS CCR** for communications, an **FS** unit must be fitted with the **Rack Interface** option and be running an application written for this purpose.

Note: The **FS CCR** can be used for communications even if the **FS** units are fitted with non-rechargeable (alkaline) batteries. **However, it is essential that charging is disabled as described in Chapter 8 of the appropriate *System Developer's Guide*.**

Note: If non-rechargeable batteries are fitted, we recommend that you remove the **FS** unit from the **FS CCR** when the communications session is complete. Do NOT store the **FS** unit on the **FS CCR** for prolonged periods.

Important: Operators of the **FS** unit and **FS CCR** should be supplied with the *User Leaflet* for that **FS** unit, which contains important safety and legislative information.

3.1 Introduction

Read this chapter before using or maintaining the **FS CCR** installation. It tells you how to:

- Start up the **FS CCR**
- Connect the **FS** units
- Monitor charging
- Monitor communications
- Disconnect the **FS** units
- Shut down the **FS CCR**
- Perform routine maintenance
- Handle problems

To control or check the **FS** units, you may need to know how to use the HOT key: with the developer's (default) keyboard selected, hold down the PAW (❀) key and press **H** to use the HOT key. For full details, see the **FS** unit's *System Developer's Guide* (eg the *Husky FS/2* and *FS3 System Developer's Guides*).

3.2 Starting up

The **FS CCR** will normally be left powered on continuously, but if you need to power it on:

- Check that the right-hand D type is connected to the host communications cable.
- Turn on each of the AC adaptors and check that the POWER LED lights on each Rack module. (If not, see section 3.10.)
- The **FS CCR** is now ready for use.

3.3 Connecting an FS unit

- Place the **FS** unit on the **FS CCR** and let it slide down between the support pillars.
- Press the **FS** unit firmly against the Rack contacts until the magnets engage.
- Check that the CONNECTED LED lights. If not, try sliding the **FS** unit up and down a couple of times to seat the contacts.
- The **FS** unit's screen should display a status message such as **`Charging in progress`** (depending on the application).
- To download data from the host or upload information to it, turn on the **FS** unit and follow your application's user instructions.

(Depending on the application, you may not need to turn on the **FS** unit or select any options to use the **FS CCR**.)

3.4 Charging

Caution: Do not attempt to recharge an FS unit **on the FS CCR unless you are sure that it contains rechargeable batteries (NOT alkaline batteries). The batteries must be correctly oriented, inserted positive end first. If alkalines are fitted, disable charging (see Chapter 8 of the FS unit's *System Developer's Guide*).**

While on the **FS CCR**, an **FS** unit will normally recharge its batteries automatically within a few hours. The time required depends on the battery state and type of **FS** unit, but for an **FS/2** with fully discharged batteries it will typically be 6 to 8 hours in Advanced Power Management (APM) mode and up to 15 hours in Standard Power Management (SPM) mode. All you need to do is:

- Check that the CONNECTED LED stays lit. IF IT DOES NOT, the contact may be poor or may have been disturbed, or the AC adaptor may be switched off (check the POWER LED). Try reseating the **FS** unit on the **FS CCR**.
- Remove the **FS** unit from the **FS CCR** once it has charged and carried out any communications required. Typically, you will simply leave it for several hours, but you can also turn the **FS** unit on and use either the application or the HOT key to check the power level (if Advanced Power Management (APM) is enabled). (See section 3.7 for more details.)

The application may be written to monitor its power level and communications requirements and tell you when you can remove it from the **FS CCR**, eg by beeping or displaying a message.

3.5 Communications

If communications are being used, they should be handled automatically by the applications running on the **FS** unit and host. Data transmissions from the host make the RECEIVE LED flicker on all the Rack modules, while data transmission from an **FS** unit makes that Rack module's TRANSMIT LED flicker.

- Check that these LEDs flicker as expected, as a simple check on operation. If more than one TRANSMIT LED lights at a time, or if any of the LEDs stays on, there is a communications problem. See section 3.10.
- The application may also display progress or error messages, so you can monitor the situation by checking the **FS** unit's display: see the application notes for details.
- Finally, if an application encounters a situation which requires your attention (such as loss of the host connection, or repeated timeouts), it may attract your attention by beeping repeatedly. Check the **FS** unit's display for instructions on what is required.

If alkaline (non-rechargeable) batteries are fitted to the **FS** unit, CHARGING MUST BE DISABLED (see section 3.4), but you can still use the **FS CCR** for communications. We recommend that you remove the **FS** unit from the **FS CCR** when the communications session is complete. Do NOT store the **FS** unit on the **FS CCR** for prolonged periods.

3.6 Using HCOM, the Husky file transfer utility

HCOM is a versatile file transfer utility supplied by Husky Computers which is designed to make transferring files between a PC and an **FS** unit quick and easy. The PC component is supplied on a diskette, while the **FS** unit component is built into its software.

General instructions for using HCOM are included in the *Husky File Transfer Utility Guide*. To connect via the **FS CCR**, observe the following additional points:

- Place the **FS** unit on the **FS CCR** and wait for the CONNECTED LED to illuminate before turning on the **FS** unit and running HCOM.
- HCOM will normally run at 38,400. When connecting via the **FS CCR** at this speed, CTS and RTS must not be connected to the host. If they are, run HCOM at 19,200 Baud instead as described in the *Husky File Transfer Utility Guide*.
- HCOM is resident in the **FS** unit's software, so you do not need to download it from the PC as described in the *Husky File Transfer Utility Guide*.

3.7 Disconnecting an FS unit

Typically, you will wait several hours (eg overnight) so that all **FS** units are fully charged and have finished communications.

- To check if communications has finished: turn on the **FS** unit and the application should display a message to this effect (perhaps after selecting an option).
- To check if charging has finished: turn on the **FS** unit and the application should display a message to this effect (perhaps after selecting an option). If not, use the HOT key to check the power level.

To remove an **FS** unit from the **FS CCR**, simply slide it back off the supports.

3.8 Shutting down

The **FS CCR** will normally be left powered on continuously, but if you need to power it down, simply power down the AC adaptors. (You do not need to disconnect any **FS** units or the host link.)

3.9 Routine maintenance

The **FS CCR** does not require significant regular maintenance, but to minimise problems you should do the following about once a week:

- Clean all the sprung contacts with a clean cloth and a mild alcohol-based cleaner, and check the springing.
- Clean the Rack contacts on the back of each **FS** unit with a clean cloth and a mild alcohol-based cleaner.
- Check the fault log. If any **FS CCR** module or **FS** unit has persistent problems, check it for faults.

In addition, to ensure that the **FS** units' rechargeable batteries retain their full capacity, we recommend that you put them through a full discharge cycle periodically (perhaps once a week, depending on usage). If your application is written to the guidelines given in Chapter 4, it will provide this facility, so refer to the application's user instructions.

3.10 Problems

This section summarises how to handle common types of problems which you may encounter while using the **FS CCR**:

Note: Log any errors and problems that you encounter, with the date, time, Rack module number and **FS** unit serial number involved, to help with fault diagnosis.

If there is a power cut or brownout while using the **FS CCR**, when power returns charging will continue correctly and the individual **FS** units should resume communications, providing the applications have been written according to the guidelines in Chapter 4.

If a Rack module does not charge and the POWER LED does not light, check the AC adaptor and supply. If this does not help, the Rack module may be faulty.

If a Rack module does not charge but the POWER LED does light, clean the Rack module's contacts and check their springs, clean the **FS** unit contacts, check that charging is enabled (eg by using the HOT key), try another **FS** unit. If this does not help, the Rack module may be faulty. If the **FS** unit has a peripheral connected, it may be drawing too much current for the AC adaptor: try disconnecting it or disabling it via the application (if it provides this option).

If none of the Rack modules charge, check the AC supply. Note that **FS** units will disable charging if the temperature is below 5°C (41°F) or above 40°C (104°F).

If a Rack module charges but does not allow communications: clean the Rack module contacts and check their springs, clean the **FS** unit contacts, try another **FS** unit. If this does not help, the Rack module may be faulty.

If an **FS** unit does not appear to display messages, the screen contrast may be too low. Adjust the contrast, for example by holding down either ⇧ (SHIFT) key and pressing ↑ or ↓.

If none of the Rack modules allow communications: check the host is operating correctly, check the host cable, and try swapping the right-hand Rack module.

If the application warns you about frequent communications errors: clean the contacts and check their springs, check that the AC supply is stable, record whether **FS** units were being added or removed when the problem occurs, check the host cable for faults, and check that each **FS** unit has a different address number in its software.

If error messages are displayed on the **FS** unit screens, refer to the Software Application's operating instructions.

Note that for communications between the **FS CCR** and the host at speeds greater than 19,200 Baud, hardware handshaking (RTS and CTS) cannot be used. You can make sure of this in one of three ways:

1 The recommended method is to use a "three wire" cable (connecting Tx, Rx and Signal Ground plus screen only). This is the simplest way to ensure success. HCOM is designed to work with this type of connection.

2 Or, if the handshake lines are connected, the communications software in both the host and the **FS** unit must fix them in the asserted (active) state throughout the communications session.

3 Or the handshake inputs can be link wired in the cable or its connector to a suitable signal to force them to the asserted state. In some installations it may be appropriate to use DTR for this purpose, if DTR is permanently asserted during communications. This solution has the advantage that software can more easily detect problems such as a cable becoming disconnected. The difficulty is that there are a number of connections and signal configurations that can work together, but everything has to be right to achieve high Baud rates!

For more information on communications speeds and hardware handshaking, refer to sections 2.8 and 4.3.2.

4. Programming

4.1 Introduction

This chapter consists of the following sections:

Background	Describes the basic principles of using the **FS CCR**, from the programmer's point of view, including the recommended communications protocol functions.
Programming notes	Describes how to implement programs on the **FS** unit and host to communicate via the **FS CCR**.

Please read both sections.

4.2 Important notes

- The **FS CCR** can be used for communications even if the **FS** units are fitted with non-rechargeable (alkaline) batteries. **However, it is essential that charging is disabled as described in chapter 8 of the FS unit's *System Developer's Guide*.**
- **The FS CCR should not be regarded as a totally error-free channel by the systems programmer. Error handling must be included in the communications protocol; see sections 4.4.7 and 4.4.8.**

4.3 Background

This section describes the basic principles of **FS CCR** communications. For a discussion of their use when implementing communications, see section 4.4.

4.3.1 The communications channel

Communications between the host and the **FS** units is achieved by modulating the data signals onto the charging lines. Handshaking signals

are transmitted by a combination of frequency shifts and D.C. voltage shifts. Therefore, communications is only possible while a current is flowing across the **FS CCR** to the **FS** unit contacts. The **FS** unit ensures that a sufficient (small) current flows even if charging is disabled.

Communications thus consists of the following steps:

Starting the link:

- When an **FS** unit is placed on the **FS CCR** a small current flows through its contacts (even if charging is disabled). The **FS CCR** checks the resistance offered by the **FS** unit to decide whether the contact is good enough for reliable communication, and provides DSR to the **FS** unit if it is.

  During this period (of about 1 second after placing on the **FS CCR**), the **FS** unit must not attempt to use COM1 (or must keep DTR off), to allow the BIOS to check for a good contact.

- The **FS** unit's application can detect that it is on an **FS CCR** by using an extended BIOS function (INT 14H, function 2EH), and switch to Rack communications by using another function (INT 14H, function 2FH). This will allow it to receive data and handshaking signals from the host.

- To send data to the host, the **FS** unit must take control of the communications link, by turning DTR on, after which all the normal RS232 signals are available, apart from DSR which should remain ON.

Using the link:

- All signals sent by the host/modem (except DSR) pass through the **FS CCR** modules, so that each connected **FS** unit receives them simultaneously. The signals to the **FS** unit from the **FS CCR** modules operate as follows:

  - DSR is not transmitted through the **FS CCR**, but the **FS** unit assumes DSR is on when it detects a communications signal from the **FS CCR**.

  - DCD and RI are combined (so that if either is present, both are seen) and transmitted with a delay not exceeding 100mSec.

    - TxD is transmitted at the configured data rate (up to a maximum of 38,400 Baud).
    - CTS is transmitted at the configured data rate (up to a maximum of 19,200 Baud).
- All signals from **FS** units to the host/modem are combined (ORed) by the **FS CCR** to form a daisy-chain, so that each signal received by the host/modem will only be off if all **FS** units are asserting it off. If no **FS** units are present, all signals are off. Note that to avoid data corruption, only one **FS** unit at a time must transmit data; this is the responsibility of the communications protocol used (see section 4.4.7).
    - In order to transmit RxD and/or RTS, DTR from the **FS unit must be ON**. The **FS** unit can only transmit these signals while DTR is ON.
    - RxD is transmitted at up to 38,400 Baud.
    - RTS is transmitted at up to 19,200 Baud.

Finishing the link:

There are two ways to end the link between an **FS** unit and the **FS CCR**:

- By an application turning DTR off. The **FS** unit can then be removed, or the link can be restarted.
- By an operator removing the **FS** unit from the **FS CCR**. The communications protocol provided by the application must detect any interruption to communications in progress at the time. The host will detect disconnection via an ACK timeout. The **FS** unit's application will detect disconnection as loss of DSR.

The first method is preferable since it greatly reduces the chance of corrupting communications.

Error handling:

There is no error detection or correction built into the **FS CCR**; this is the responsibility of the applications running on the host and individual **FS** units (see section 4.4.7).

4.3.2 Communications speeds

The **FS CCR** supports communications speeds up to a maximum of 38,400 Baud. However, the following limitations apply to RTS/CTS handshaking.

- Communications with full RTS/CTS handshaking is supported to a maximum of 19,200 Baud only, whether half duplex or full duplex.
- Communications at speeds greater than 19,200 Baud up to a maximum of 38,400 Baud is only supported WITHOUT RTS/CTS handshaking. You must ensure that:

  i) The **FS** unit RTS signal (on COM1) is set permanently OFF (inactive) during communications.

  ii) Either RTS and CTS are NOT connected in the Host to Rack cable.

  Or, if a "crossed" cable is used (see Appendix A.6), ensure that the Host sets the RTS signal to OFF (inactive), to produce a "line low" state on the cable.

For more information on communications speeds and hardware handshaking, see sections 2.8 and 4.3.2.

4.4 Programming notes

4.4.1 General principles

To communicate via the **FS CCR**, an application should be running on the **FS** unit and the **FS** unit must be turned on when it's being placed on the **FS CCR** or once it is on the **FS CCR**. This application must detect it is on the **FS CCR**, switch from using the main communications port (Port 1) to communications via the charging contacts, and then implement a protocol to allow shared use of the link with the host and handle communications errors and disconnection. It should also keep the operator informed of progress or problems, by audible alarms and/or displayed messages.

If the host connection is via a modem, the application can enable the RI (Ring Indicator) event and then power down; it will then "wake up" automatically when the host dials in, so it can handle communications. Note that the Rack is connected via the **FS** unit's COM1 only.

For more details of any of the **FS** unit's interrupts described in this guide, see the **FS** unit's *System Developer's Guide*.

4.4.2 Enabling charging

To use the **FS CCR** for charging, you must check that the **FS** unit is fitted with suitable rechargeable batteries, then enable charging by using INT 15H, function 7FH.

Caution: Do not attempt to recharge an FS unit on the FS CCR unless you are sure that it contains rechargeable batteries (NOT alkaline batteries).

To provide accurate monitoring of charging, use Advanced Power Monitoring (APM), selected by using interrupt INT 15H, function 89H. Select charging authorisation 4, by using INT 15H, function 65H. You can disable charging when the **FS** unit is removed from the **FS CCR**, as described in section 4.4.10.

Note: The **FS** unit will disable charging if the temperature drops below 5°C (41°F) or rises above 40°C (104°F).

To ensure that rechargeable batteries retain their fully capacity, they should be put through a full discharge cycle periodically (perhaps once a week, depending on usage). This facility is provided via an **FS** unit BIOS function, which you should access from your application.

Caution: While charging on the FS CCR, the FS unit's ability to power peripherals is reduced or removed altogether (depending on the power management mode), so use of peripherals while on the FS CCR must be carefully controlled. For details, see section 4.4.9.

4.4.3 Detecting the FS CCR

To use the **FS CCR**, the operator must select the application's "Download data" or "Host communications" option, either before or after placing the **FS** unit on the **FS CCR**. The application should then display a message, for example:

```
Checking link.
DO NOT TURN OFF YET!
```

The application can then check whether it is on the **FS CCR** by using INT 14H function 2EH.

Note: To allow the **FS CCR** to detect its presence, the **FS** unit must not initiate any communications within 1 second of being placed on the **FS CCR** ie it must set DTR to OFF.

If it is on the **FS CCR**, the application can proceed with the next stage, described in the next section.

If the application does not detect the **FS CCR**, it should ensure that normal communications is selected (INT 14H function 2FH), then check COM1 DSR:

- If DSR is on, the **FS** unit is connected directly to the host. If so, the remainder of this chapter does not apply!

- If DSR is off, the **FS** unit might not be mounted properly on the **FS CCR**, or the Rack module might be faulty. Prompt the operator to check and press ⏎, then check for presence on the Rack again.

4.4.4 Selecting FS CCR communications

Now you have established that the **FS** unit is on the **FS CCR**:

- Select Rack communications by using INT 14H function 2FH.
- Ensure that COM1 DTR is off (INT 14H function 2CH) and wait for at least 1 second (to allow the **FS CCR** to detect the **FS** unit).
- Check DSR to see if the connection (to the **FS CCR**) is good:
  - If DSR is on, proceed to the next section, with DTR still off.
  - If DSR is off, display an error message such as **`Please check connection with FS CCR. Continue (Y/N)`**. If the user replies Y, check DSR again. If the user replies N, disable Rack communications (INT 14H function 2FH), leave DTR off and exit communications.

Note: If the application does not turn DTR off and wait for 1 second, the **FS CCR** will not detect the **FS** unit. The **FS** unit will be able to receive data from the host, but will not be able to send data. The CONNECTED LED will also remain off.

4.4.5 Receiving data

You have now established that the **FS** unit is connected to the **FS CCR** with a good contact. At this stage, any data or handshaking from the host will be received by the **FS** unit (and any other **FS** units on the **FS CCR**).

To receive data, use the appropriate BIOS functions, direct hardware I/O addressing or standard COM1 interrupts (IRQ4).

If connected via a modem, the modem will turn DCD on while on-line, to show that received data is valid. Ignore data received while DCD is off.

Typically, data is transmitted in blocks, which include address numbers to direct the data block to the appropriate **FS** unit, error-detection, and link control blocks. See section 4.4.7 for details of the protocol.

If connected via a modem and DCD is off, the modem is not on-line. **FS** units can enable the RI event, with the event handling routine pointing to the DCD detect loop, and turn off. When the host dials in, RI will wake all the **FS** units. (Via the **FS CCR**, DCD and RI are indistinguishable.)

4.4.6 Sending data

To send data to the host, an **FS** unit must first turn DTR on.

To share the single line between the multiple **FS** units, the host will normally poll them by their address number to invite them to begin transmitting. (Alternatively, each **FS** unit could have a separate time slot within which it can transmit, but this is rather less flexible.)

4.4.7 The communications protocol

The **FS CCR** does not include error-handling or collision-avoidance mechanisms; these are the responsibility of the applications running on the host and individual **FS** units, and are defined as a communications protocol. The details of the communications protocol are left to the applications writer, however, the following suggestions may help:

Collision avoidance:

Since all data transmitted by **FS** units is ORed, only one **FS** unit at a time must transmit data to the host/modem. To do this, an **FS** unit asserts DTR ON (eg by using INT 14H, function 2CH). To make sure that only one **FS** unit at a time transmits, either the host application must poll each (possible) **FS** unit in turn, granting it permission to transmit, or each **FS** unit must be assigned a separate fixed time slot. Polling is preferred as it is more reliable and resilient.

Polling requires that each **FS** unit has a unique "address" that the host can use, stored in the unit's application. The host loops through its list of **FS** units, polling each one in turn until it gets a positive response. It then

exchanges messages with that **FS** unit, terminates the link with it, and removes it from its list and continues polling the remaining units. This loop might iterate until a fixed time, until all **FS** units have been serviced, or until the operator intervenes.

Note that the individual **FS CCR** modules are all equivalent; **they** do not themselves have "addresses", the **FS** units do.

Broadcast messages:

As all **FS** units on the **FS CCR** can receive any of the data received from the host, "broadcast messages" which are intended for all **FS** units can easily be sent by using a unique block type. To direct a message to a particular **FS** unit, label it with that unit's "address".

Error handling:

Communications errors may be introduced by many different factors, including line noise, adding **FS** units to or removing **FS** units from the **FS CCR** during a communications session, knocking the **FS CCR** during a communications session, and faulty equipment. To minimise problems, the applications running on the host and **FS** units **must** implement a robust (fault-tolerant) protocol.

Summary:

The communications protocol must therefore include:

- Identification of each **FS** unit by a unique number, used by the host to address messages to that unit and invite it to take control of the link, when appropriate (polling).
- Control blocks, to select the correct **FS** unit and manage transitions between the various stages such as host transmit, **FS** unit transmit, and link terminate.
- Data blocking, which parcels information into manageable portions so that error-handling does not become unwieldy.
- Checksums on each block, so that the receiver can detect data errors.

- Positive (ACK) and negative acknowledgements (NACK), so that the receiver can request re-transmission of a corrupted block (by sending a NACK), while the transmitter can detect that a block has not been received correctly (no ACK received).
- Re-transmission of blocks when appropriate (eg NACK). The transmitter must only re-transmit a limited number of times before terminating the link (with suitable alarms/log messages), so a repeated communications error won't lock up the system.
- Time-outs, so a fatal communications error won't lock up the system.
- DSR polling by the **FS** unit's application. If DSR is lost, the connection to the **FS CCR** has been lost and data may be invalid. The **FS** unit should ignore the current block and start the connection sequence again, or the host should time out and attempt to re-establish the link.

EXAMPLE PROTOCOL: polling with a fixed list:

- The host compiles a list of address numbers for the **FS** units with which to communicate, then sets a counter to the start of the list.
- The host polls the next **FS** unit in its list.
- The host waits for a short period (eg 5 seconds) for a positive acknowledgement (ACK) from that **FS/2**.
- If it receives an ACK, the host exchanges messages with that **FS** unit and then removes the address number from its list.
- If the list is not empty, the host sets the counter to the next **FS** unit in the list and carries on from the second step.

EXAMPLE PROTOCOL: exchange with a single FS unit:

- The host sends a POLL block with the address number (eg 17), then waits for a few seconds for a reply.
- **FS** unit 17 detects a poll for its number and raises DTR to use the link. It then sends a positive acknowledge block (ACK) within the time limit, or a negative acknowledge block (NACK) if it recognises its address number but the block is otherwise corrupted (the host will re-transmit the POLL block; see below).

Note: If the block checksum includes the address and the **FS** unit detects a checksum error, then it will discard the whole block including the address. The **FS** unit will not send a NACK, the host will time out instead.

- The host sends a header block indicating the amount of data it is going to send to **FS** unit 17. (This block, and all subsequently sent by the host, has address number 17 embedded in it so other **FS** units will ignore it.) This amount may be 0.
- The **FS** unit acknowledges the header block with an ACK if it can receive this data, or a NO block if it cannot, or a NACK if the block is corrupted. (NACK makes the host send it again. NO makes the host skip the HOST TO FS UNIT stage.)
- The host sends each data block in turn and waits for the acknowledgement.
- **FS** unit 17 ACKs (data OK) or NACKs (data not OK) each block received, extracting and storing the data if valid. Each block includes a serial number, so that if the same block is received twice, the receiver can ignore it (but still send an ACK).
- Once the host has successfully sent all the blocks, the FS UNIT TO HOST stage can begin. The host waits for **FS** unit 17 to send a data header.
- **FS** unit 17 sends a header block to the host indicating the amount of data it is going to send. This amount may be 0. This block can include the **FS** unit address number as confirmation for the host, but does not need any other address information, as the other **FS** units on the **FS CCR** don't receive data sent by another **FS** unit on the **FS CCR**.
- The host acknowledges the header block with an ACK if it can receive this data, or a NO block if it cannot, or a NACK if the block is corrupted.
- **FS** unit 17 sends each data block in turn and waits for the acknowledgement, as described for host to **FS** unit communications.
- When **FS** unit 17 has received an ACK for its last data block, it sends an END block to the host, and releases the link (see below).

EXAMPLE PROTOCOL: detecting and handling errors:

- The transmitter adds error-checking data (such as a cyclic redundancy checksum, CRC) to each block.
- The receiver calculates its own CRC from the received data. If this matches the received CRC, it uses the data and returns an ACK. If it does not, it ignores the data and returns a NACK.
- If the transmitter receives an ACK, it proceeds with the next data block.
- If the transmitter receives a NACK, a corrupt acknowledge, or no acknowledge within a timeout period (eg 5 seconds), it sends the same block again, incrementing a counter. If this counter reaches a fixed limit (eg 5), it sends a CANCEL block and releases the link.
- If the receiver receives a CANCEL block, it releases the link.
- If the receiver does not receive the next block within a timeout period (eg 5 seconds), it sends a NACK block and increments a counter. If this counter reaches a fixed limit (eg 5), it releases the link.
- An **FS** unit should immediately release the link if it receives a POLL block with another **FS** unit's number in it.
- Both receiver and transmitter should also monitor the appropriate handshaking lines to ensure data validity, as is usual with communications applications. In particular it is essential for the **FS** unit to monitor DSR, since the presence of this signal indicates a "good" Rack connection.
- The host and **FS** unit may optionally log errors, sound alarms, display warnings, and attempt to re-establish a link which has failed.

EXAMPLE PROTOCOL: releasing the link:

- To release the link, an **FS** unit turns DTR off. If it has successfully completed all its communications, it should also disable rack communications and turn off, as described in section 4.4.10. If communications has been interrupted, it can re-start the link as described in section 4.4.4.
- To release the link to the current **FS** unit, the host sends a POLL block for the next **FS** unit.

- To release the link to the entire **FS CCR** (eg if all **FS** units in its list have been communicated with, or if the link is very noisy), the host turns DTR off (if this signal is connected from the host), or allows the link to time out.

4.4.8 Low level error handling

The following error conditions should be monitored continuously and appropriate actions taken:

- Loss of DSR: the connection to the **FS CCR** has been lost. For example, the **FS** unit may have been removed from the **FS CCR**, or the contacts may have been disturbed. Ask the operator to indicate which, by sounding an alarm and displaying a prompt such as:

  ```
  DISCONNECTED FROM FS CCR!
  PRESS:
  Y if removed from FS CCR
  N to retry after remounting
  ```

  - If the operator presses Y, disconnect as described in section 4.4.10.
  - If the operator presses N, switch off DTR from the **FS** unit, wait 2 seconds, then enable it again (INT 14H function 2CH), then re-establish contact as described in section 4.4.3.
- Loss of DCD: the host (modem) connection has been lost. For example, the communications session may have finished, or the host or line may be faulty. Alert the operator by sounding an alarm and displaying a prompt like this:

  ```
  LOST HOST CONNECTION!
  CHECK CONNECTION THEN PRESS
  C to continue communications
  F to finish communications
  ```

  - If the operator presses C, return to the communications routine, discarding the current block.
  - If the operator presses F, disconnect as described in section 4.4.10.

- Timeouts: are handled as described in section 4.4.7. Timeouts indicating loss of the host connection can be handled as described above for loss of DCD.

4.4.9 Using peripherals while on the FS CCR

When you enable Rack communications, access to the **FS** unit's ports is affected as follows:

- Port 1 (COM1) is disabled, so you cannot access it. (COM1 access is redirected to the **FS CCR**.)
- Ports 2 and 3 are still available, but can only transmit data at TTL levels rather than RS232 levels ie these ports are forced (temporarily) into the TTL level state.

If these limitations are not acceptable, the application can disable Rack communications temporarily when required, using INT 14H, function 2FH.

While on the **FS CCR** and actually charging, the current available to peripherals via the **FS** unit's ports is restricted as follows:

- In Advanced Power Management (APM) mode, **NO** surplus current is available to power peripherals. If peripherals are connected which normally draw current from these ports, you **MUST** disable power output to Ports 1, 2 and 3 as described in chapter 26 of the **FS** unit's *System Developer's Guide*, BEFORE THE FS UNIT IS PLACED ON THE **FS CCR**. You should instruct operators to always select the "Rack communications" option BEFORE placing the **FS** unit on the **FS CCR**, and turn the peripheral power off in the Rack initialisation code.
- In Standard Power management (SPM) mode, the total power output is limited to 100mA. If peripherals are connected which can draw more current than this, you must disable power output and instruct the operators as described for APM mode.

If the peripherals are only powered while being accessed, the application can instead simply disable access to them while on the Rack.

Caution: If you ignore these precautions and an FS unit's peripheral draws more power than allowed while on the FS CCR, it may fail to operate correctly, disrupting communications and charging for all FS units on the FS CCR at that time.

(If these power output restrictions are not acceptable, the application can restore normal power output temporarily by disabling charging: in APM mode use INT 15H, function 7FH; in SPM mode, use INT 15H, function 8AH. See the **FS** unit's System Developer's Guide for more details.)

4.4.10 Removal from the FS CCR

An operator can remove an **FS** unit from the **FS CCR** at any time by simply lifting it up. To avoid operators removing an **FS** unit before it has finished charging and communications, the application should display status messages indicating the progress and completion of charging and communications (eg as a "percentage complete" bar), or a warning message such as **`COMMUNICATIONS IN PROGRESS - DO NOT REMOVE`**, and you should instruct the operators to check the display before removing the **FS** unit.

When an **FS** unit is removed from the **FS CCR** it may cause line noise. The application's communications protocol must make sure that this does not interfere with communications by other **FS** units at that time, by detecting and recovering from any such errors automatically.

The best technique, then, is to enable Advanced Power Monitoring (so the application can check the battery level). The application should check the power level (eg in a loop); when it is 100% and communications has finished, it should:

- Sound a short bleep and/or display a message like this:

  ```
  Communications and charging complete at
  03:35. Remove from FS CCR.
  ```

- Turn off (INT 15H function 68H).

Alternatively, the application could display the percentage charge continuously, for example as a "thermometer" bar.

However, in a typical application (with charging and communications overnight) where there is plenty of time for charging and communications, simpler techniques may be adequate. For example, you could set up a timer event to turn on and do the above shortly before operators are due to remove the **FS** units from the **FS CCR**.

If the operator removes an **FS** unit from the **FS CCR** while it is turned on, the application can detect this by the loss of DSR, then sound an alarm, display a warning message, or simply turn off, as appropriate.

4.4.11 Using a local printer

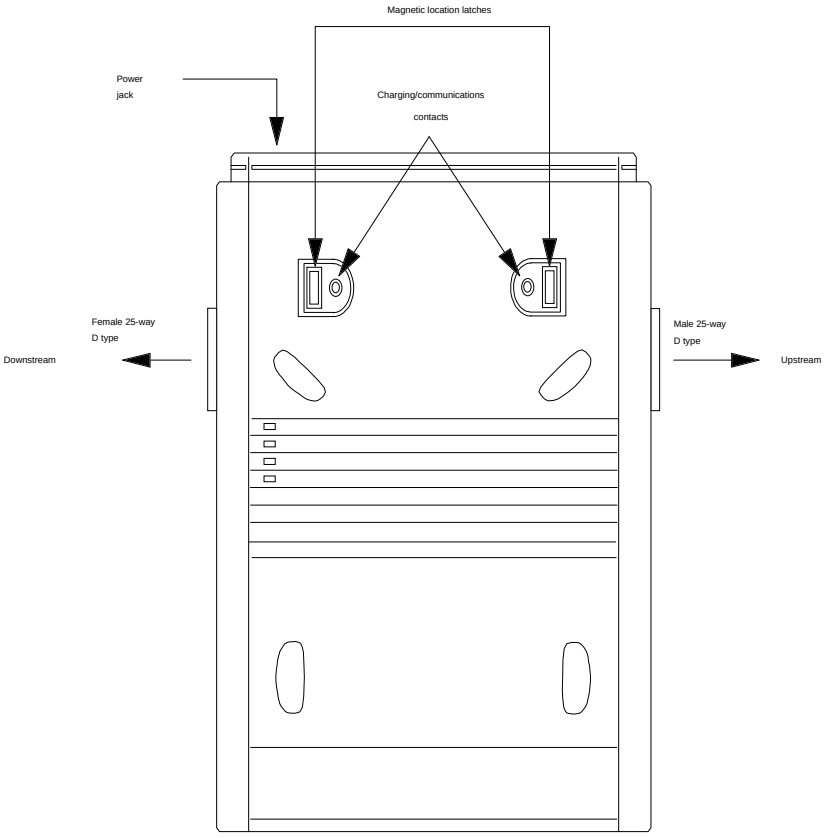
A serial printer can be connected to the right-hand end of the **FS CCR** instead of the host, by using a crossed cable (see Appendix A.6). To print on this printer, a much simpler **FS CCR** application is required, as a printer cannot implement polling or an error-detection communications protocol!

This arrangement is most suitable for installations consisting of a single Rack module. If it is used with multiple modules, to avoid problems with two applications trying to print at the same time, they should either prompt the operator to indicate when it can start printing, or each **FS** unit should have a different fixed time period in which it is allowed to print.

5. Appendices

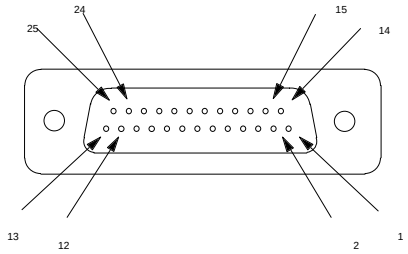
Appendix A: Pinouts and cables

The connector positions are as follows:



A.1 25-way D type, male

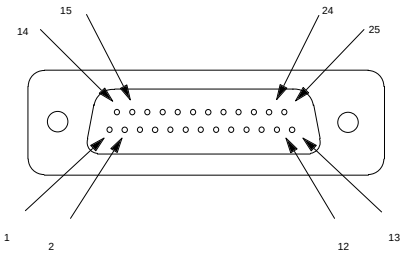
This connector is on the right-hand side of the Rack module. It connects to the host or modem, or to the next Rack module which is "upstream" (nearer the host) in the **FS CCR** installation.



Pin	Description	
1	Chassis Ground	
2	Transmitted Data	(towards host)
3	Received Data	(from host)
4	Request to Send	(towards host)
5	Clear to Send	(from host)
6	Data Set Ready	(from host)
7	Signal 0 V	
8	Data Carrier Detect	(from host)
20	Data Terminal Ready	(towards host)
22	Ring Indicator	(from host)
25	+DC power in/out	(see A.4)

A.2 25-way D type, female

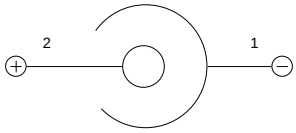
This connector is on the left-hand side of the Rack module. It connects to the next Rack module which is "downstream" from (away from) the host in the **FS CCR** installation.



Pin	Description	
1	Chassis Ground	
2	Transmitted Data	(from next module)
3	Received Data	(to next module)
4	Request to Send	(from next module)
5	Clear to Send	(to next module)
6	Data Set Ready	(to next module)
7	Signal Ground	
8	Data Carrier Detect	(to next module)
20	Data Terminal Ready	(from next module)
22	Ring Indicator	(to next module)
25	+DC power in/out	(see A.4)

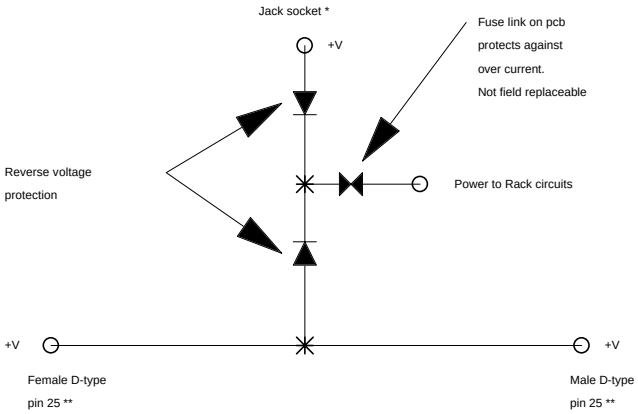
A.3 Power jack socket

The power jack at the top of each Rack module is the low voltage DC input, providing power to that module only:



Pin	Description
1	Chassis Ground (0V)
2	DC power in (+V). See A.4.

A.4 Power In/Out



* The jack socket is rated to carry 1A maximum and is reverse polarity protected.

** Pins 25 can carry up to 5A maximum, and are reverse polarity protected.

The diodes protect against reverse voltage and prevent a higher voltage applied at pin 25 from supplying reverse current into a power supply connected to the power jack socket, and vice versa. Note that the pcb fuse link (which protects against over current being drawn by the Rack electronics) is not field replaceable.

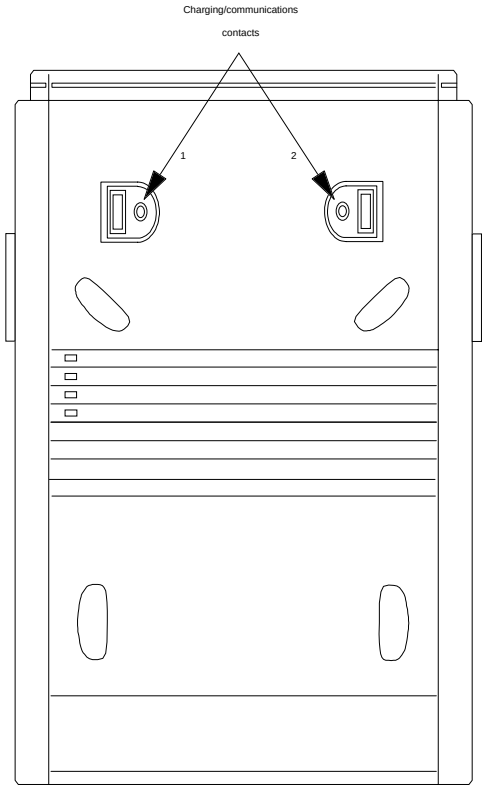
The input voltage requirements are:

DC power in	
Absolute minimum voltage	11.0V
Nominal voltage	12.0V
Maximum continuous	15.0V

Note: The power supplied via the jack socket is **not** passed through to other Rack modules in the chain.

A.5 Spring contacts

The contacts on the front surface of the **FS CCR** mate with matching contacts on the underside of the **FS** unit:



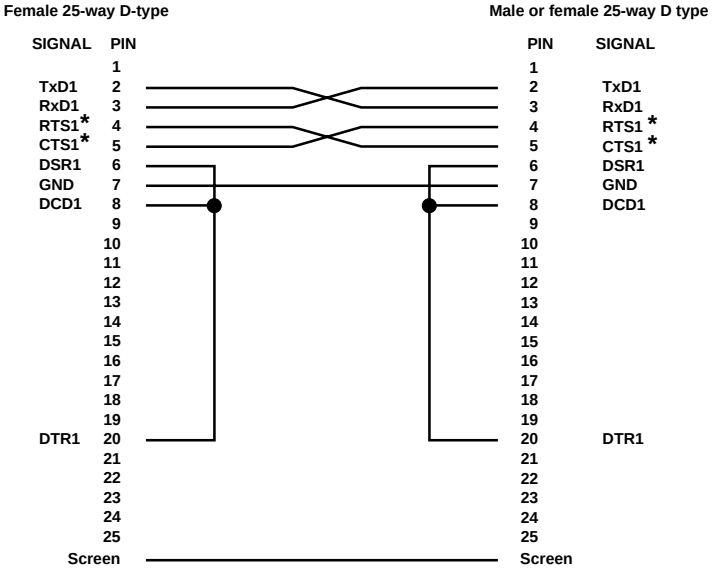
Pin	Description
1 2	Chassis Ground (0V) Charging voltage/communications (+V)

The contacts are protected against short circuits and over current.

A.6 Example cables

The recommended maximum length for any cables used to connect to the **FS CCR** is 5 metres (16 feet). To connect to a host PC, you will need a null-modem or "crossed" cable. Depending on the type of serial connector on the host, you will need either a 25-way or 9-way connector at that end of the cable:

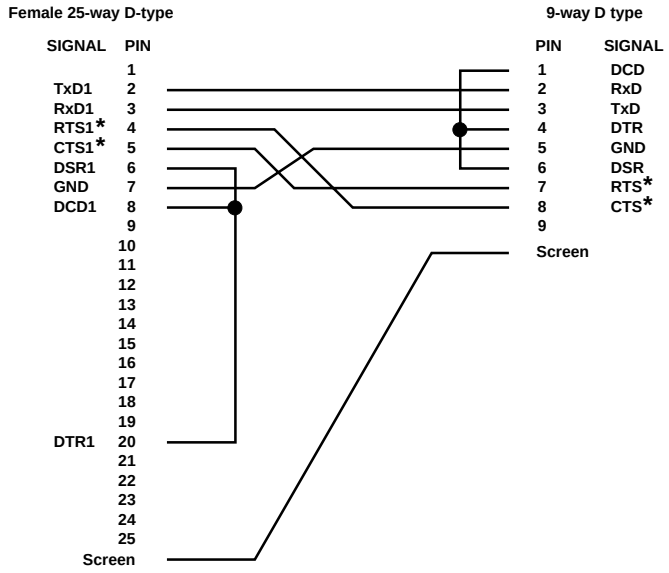
25-way "crossed" cable - available as Husky part number P-1940-0000



EMC Shielding: The screen is connected to each connector's cover and shell.

* Do not connect the RTS and CTS handshake lines for communications speeds greater than 19,200 Baud - refer to section 2.8. A suitable cable is available as Husky part number P-1940-1100, which connects only Tx, Rx and GND (a "three wire crossed" cable).

9-way "crossed" cable - available as Husky part number P-1940-0002

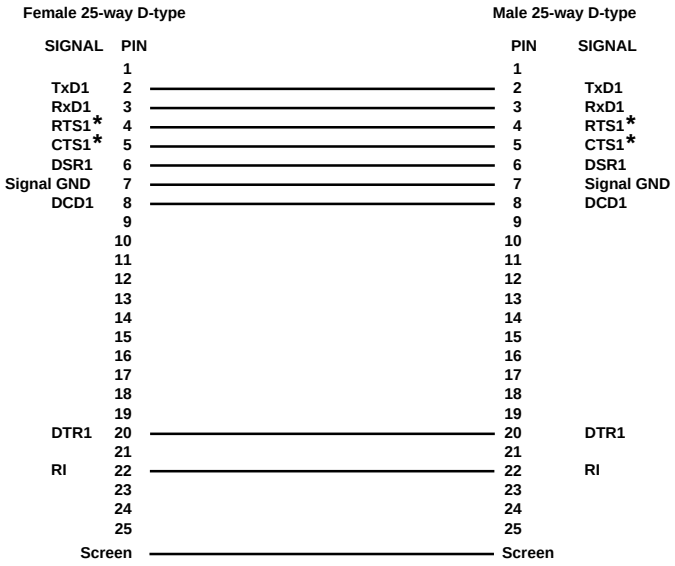


EMC Shielding: The screen is connected to each connector's cover and shell.

* Do not connect the RTS and CTS handshake lines for communications speeds greater than 19,200 Baud - refer to section 2.8. A suitable cable is available as Husky part number P-1940-1102, which connects only Tx, Rx and GND (a "three wire crossed" cable).

To connect to a modem or printer, or to daisy-chain **FS CCR** installations, you will need a "straight" cable, with 25-way D type connectors:

25-way "straight" cable - available as Husky part number P-1940-1000



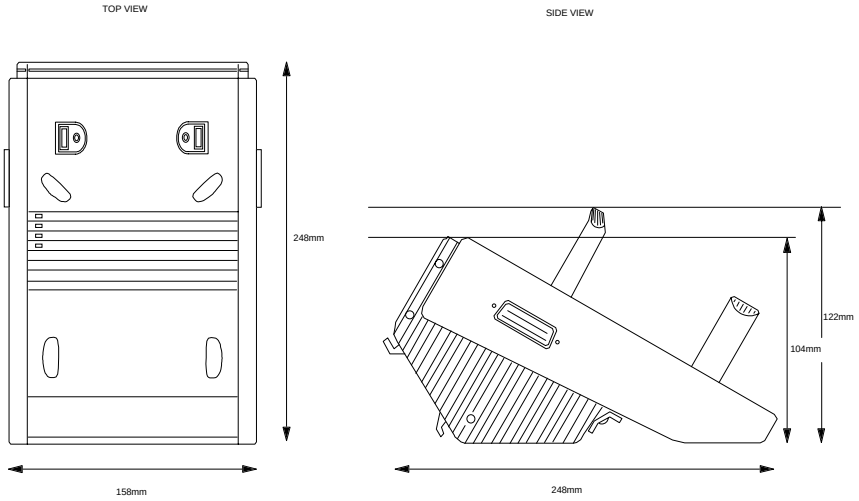
EMC Shielding: The screen is connected to each connector's cover and shell.

* Do not connect the RTS and CTS handshake lines for communications speeds greater than 19,200 Baud - refer to section 2.8.

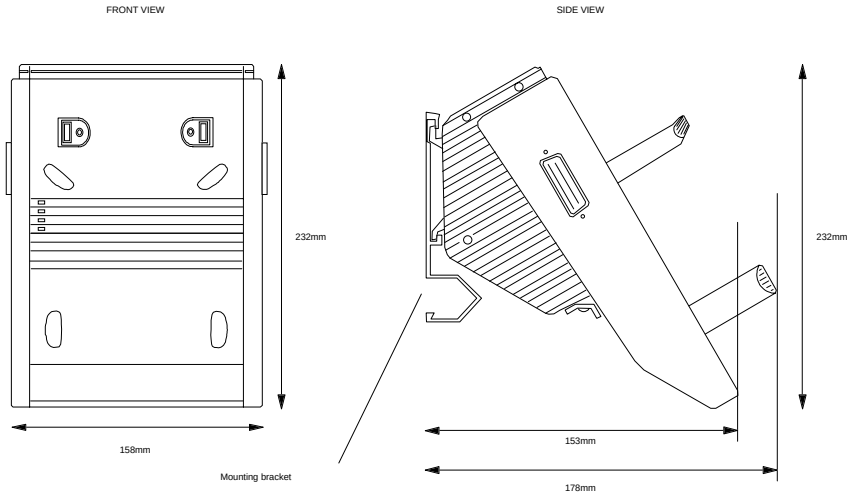
Appendix B: Specification

B.1 Physical

Construction	Extruded aluminium with durable abrasion-resistant grey paint finish. Moulded black self-coloured plastic end caps and padded **FS** unit supports. Mounting bar and joining bar: black anodised aluminium.
Size, Bench mounted	248mm (9.76 ins) deep 158mm (6.22 ins) wide excluding connectors 104mm (4.10 ins) high excluding **FS** unit supports 122mm (5.00 ins) high including **FS** unit supports



Size, Wall mounted	153mm (6.02 ins) deep excluding **FS** unit supports 178mm (7.01 ins) deep including **FS** unit supports 158mm (6.22 ins) wide excluding connectors 232mm (9.13 ins) high



Weight	1100 grams (37 oz).

B.2 Communications

Type	Full duplex between host and **FS** units, by modulating the charging voltage. Host may be replaced by local printer or modem.
Baud rate	Up to 38,400 Baud (TxD and RxD **ONLY**). Up to 19,200 Baud (TxD, RxD, CTS and RTS).
Signals	RxD, TxD, RTS, CTS, DCD+RI (ORed), DTR. DSR is emulated by the **FS** unit.

Delays	A propagation delay not exceeding 5 microseconds through each Rack module (between host connector and downstream connector), which may limit the Baud rate in large installations. Propagation delays of approximately 100mS on DCD+RI.
Indicator LEDs	CONNECTED - good contact with the **FS** unit RECEIVE - data being received by the **FS CCR** TRANSMIT - data being sent by the **FS** unit POWER - good power to Rack module

B.3 Environment

Operating temperature	-10°C to +50°C (14°F to +122°F). **Note: FS** units will disable charging when operating below 5°C (41°F) or above 40°C (104°F).
Storage temperature	-30°C to +70°C (-22°F to +158°F).
Environment	Designed for indoor operation. Not recommended in areas with excessive dust build-up or corrosive atmospheres.
Moisture	Will operate continuously at 90% relative humidity, non-condensing.
Electromagnetic	Refer to the EMC statements near the end of this guide.
Electrostatic	Conforms to EN50082 and IEC 801-2. discharge
Chemical resistance	Designed to tolerate normal surface contaminants found in office and commercial environments.

UV	Withstands levels of UV normally found in an indoor environment.

B.4 Options

Mounting kit	Bracket and screws for fastening **FS CCR** to walls etc.
Joining kit	Joining bars and screws for retaining multi-module installations.
Power supplies	AC adaptors for powering **FS CCR**s from AC supply.
Labels	Additional self-adhesive write-on labels.
Cables	To connect to: An external modem. A host PC. Other **FS CCR** installations.
Software	Husky file transfer utility (HCOM).
In-vehicle installation	Consult your FS system supplier.

AC Adaptor - Precautions

USE THE AC POWER ADAPTOR ONLY AFTER READING AND UNDERSTANDING THE FOLLOWING PRECAUTIONS.

Husky AC Adaptors are class II (double insulated with no earth) and built to EN60950: 1988 or EN60742: 1989, BS415 and DIR73/23/EEC safety requirements, and international EMC standards including EN55022 classes A and B.

Husky AC Adaptors supplied for use in North America meet UL safety requirements, FCC Part 15 EMC regulations (classes A and B), and CSA EMC regulations (classes A and B).

- Hazardous voltages inside, do not attempt to open.
- No user serviceable parts inside, do not attempt to open.
- Indoor use only.
- Avoid liquid spillage, do not connect if suspected damp.
- Ensure ventilation is not restricted.
- Use only the **FS CCR AC Adaptor**. This special adaptor should never be l replaced by an alternative unapproved model, as damage may result.
- Inspect adaptor before connecting, do not use if there are signs of damage l or deterioration.
- Ensure rechargeable batteries are fitted and they are oriented correctly.
- Battery chemical leakage is corrosive, do not touch. (In case of l accidental contact wash immediately with running water.)
- Ensure connectors are firmly mated.
- Avoid mechanical strain to cables or connectors.
- Switch on or connect mains (line) supply only after making all l connections.
- Switch off or disconnect mains (line) supply before disconnecting.
- In the event of overloading due to a fault, the adaptor is designed to be l fail safe and may stop functioning.
- Do not attempt to employ the **FS CCR AC Adaptor** for alternative purposes.
- Use only a readily accessible power outlet, and disconnect when not in l use.
- Although the **FS CCR AC Adaptor** is rated for continuous operation, it is l important not to exceed the charging limitations of the battery. Refer to appropriate instructions on charging regime.
- Avoid use in dusty or contaminated environments.

Electromagnetic Compatibility (EMC)

! CAUTION

Approved accessories only may be used with this equipment. In general all cables must be high quality, shielded, correctly terminated and normally restricted to 2 metres length. **FS CCR** AC Adaptors employ special provisions to avoid radio interference and should not be altered or substituted.

Unapproved modifications or operation beyond or in conflict with these instructions for use may void authorisation to operate the equipment.

Europe

This apparatus complies with the radio interference protection requirements of the Council Directive 89/336/EC on the approximation of the laws of the Member States of the European Union relating to electromagnetic compatibility. The product was tested in a typical configuration and found to conform to the following test specifications:

EN55022 Radiated and conducted emissions

Class A for an installation consisting of multiple inter- connected CCR modules.

Class B for an installation consisting of a single CCR module.

EN50082 ESD and radiated and conducted immunity.

Warning: Class A products, intended for use only in commercial and industrial environments, may cause interference in a domestic environment, in which case the user may be required to take appropriate countermeasures. Products which only conform to residential, commercial and light industrial immunity testing, may suffer from malfunction in a heavy industrial environment.

For further compliance details, refer to the specific CE Declaration Of Conformity. This is available on request, quote the exact and full order code for the product(s) in question.

USA

The following note applies to an installation consisting of multiple inter-connected CCR Modules:

NOTE: This equipment has been tested and found to comply with the limits for a Class A digital device, pursuant to Part 15 of the FCC Rules. These limits are designed to provide reasonable protection against harmful interference when the equipment is operated in a commercial environment. This equipment generates, uses, and can radiate radio frequency energy, and if not installed and used in accordance with the instruction manual, may cause harmful interference to radio communications. Operation of this equipment in a residential area is likely to cause harmful interference in which case the user will be required to correct the interference at his own expense.

The following note applies to an installation consisting of a single CCR Module:

NOTE: This equipment has been tested and found to comply with the limits for a Class B digital device, pursuant to Part 15 of the FCC Rules. These limits are designed to provide reasonable protection against harmful interference in a residential environment. This equipment generates, uses, and can radiate radio frequency energy, and if not installed and used in accordance with the instructions, may cause harmful interference to radio communications. However, there is no guarantee that interference will not occur in a particular installation. If this equipment does cause harmful interference to radio or television reception, which can be determined by turning the equipment off and on, the user is encouraged to try to correct the interference by one or more of the following measures:

- Reorient or relocate the receiving antenna.
- Increase the separation between the equipment and the receiver.
- Connect the equipment into an outlet on a circuit different from that to which the receiver is connected.
- Consult the dealer or an experienced radio/TV technician for help.

Canada

The following note applies to an installation consisting of multiple inter-connected CCR modules:

La note suivante s'applique aux installations comportant plusieurs modules CCR interconnectés:

This Class A digital apparatus meets all requirements of the Canadian Interference-Causing Equipment Regulations (ICES-003).

Cet appareil numérique de la classe A respecte toutes les exigences du Règlement sur le matériel brouilleur du Canada (NMB-003).

The following note applies to an installation consisting of a single CCR Module:

La note suivante s'applique aux installations ne comportant qu'un seul module CCR:

This Class B digital apparatus meets all requirements of the Canadian Interference-Causing Equipment Regulations (ICES-003).

Cet appareil numérique de la classe B respecte toutes les exigences du Règlement sur le matériel brouilleur du Canada (NMB-003).

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